



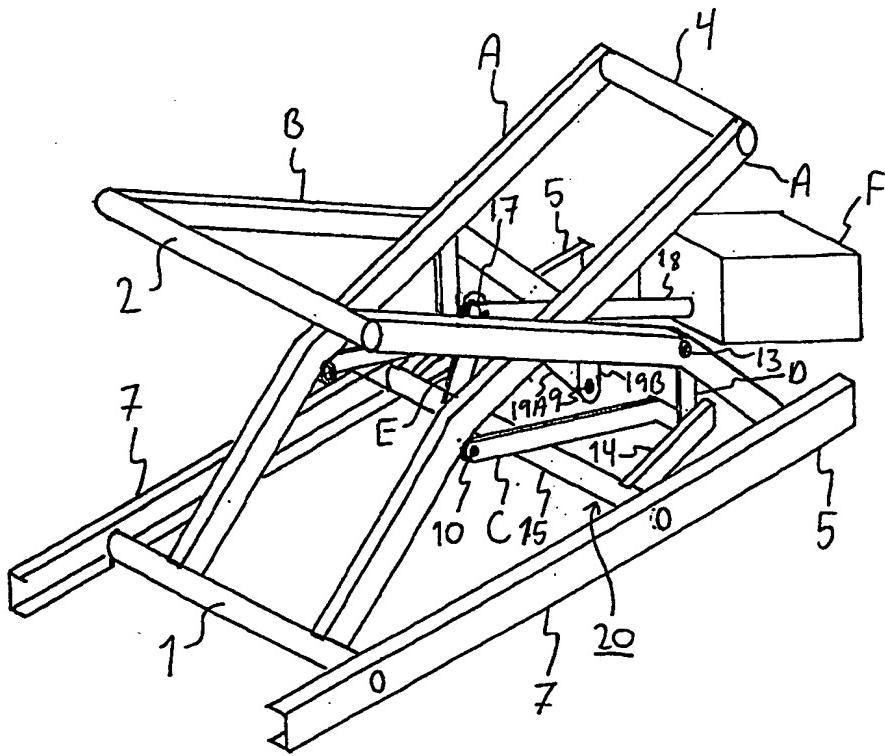
## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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## (54) Title: LIFTING MECHANISM

## (57) Abstract

Lifting mechanism for vertically displacing a platform (8) in relation to a chassis (7) and comprising a drive unit, at least one pair of arms (B, A) which are pivotally connected like scissors in a point (9) dividing said arms (B, A) into upper and lower parts in a scissors-like manner, whereby the first ends (1, 2) of the arms of the pair of arms (B, A) are hinged to the chassis (7) and the platform (8), respectively, whereas the opposite end (5) of the one arm (B) is guided along a track (5) on the chassis (7) and the opposite end (4) of the other arm (A) supports the platform (8), and a first and second rod (C, D), which at their individual one end are pivotally connected to each other in a joint (11) having an associated rolling or sliding member (12), and at their individual other ends (10, 13) are pivotally connected to the lower parts of the first and the second arms, respectively. At the chassis (7) a pivotal member (20) is mounted, which is movable by means of the drive unit and displaceably connected to the rolling or sliding member (12) in such a way that the pivotal movement of the pivotal member (20) displaces the platform (8) vertically via the rods (C, D) and the scissor arms (A, B).



## LIFTING MECHANISM

The present invention relates to a lifting mechanism for vertically displacing a platform in relation to a chassis and comprising a drive unit, at least one pair of arms which are pivotally connected like scissors in a point dividing said arms into upper and lower parts in a scissors-like manner, whereby the first ends of the arms of the pair of arms are hinged to the chassis and the platform, respectively, whereas the opposite end of one arm is guided along a track on the chassis and the opposite end of the other arm supports the platform, and a first and a second rod, which at their individual one end are pivotally connected to 15 each other in a joint having an associated rolling or sliding member, and at their individual other ends are pivotally connected to the lower parts of the first and the second arms, respectively.

Such scissor-employed lifting mechanisms usually have the disadvantage that the force to be supplied by the drive unit during the lifting movement may vary considerably during the lifting process. Typically, the process requires a very high force initially, when the scissors are in a lower collapsed position, whereas the force needed at the end of the process is considerably lower. Furthermore, it is the aim to obtain a constant lifting speed of the platform at a given constant drive unit working speed.

In connection with such lifting mechanisms, the dimensions of the drive unit must thus be adapted to the maximum force (or maximum torque) needed, which makes it overdimensioned during much of the process. Furthermore, in certain areas, the mechanism may be exposed to very large forces so that some of components transmitting the force may possibly have to be over-

dimensioned as well.

Since such an overdimensioning will inevitably increase the costs, e.g. for larger motors, sturdier components etc., various solutions have been suggested 5 how to equalize the forces during the process.

In EP-A-0 839 757 such a lifting mechanism is disclosed having a pair of scissor arms connected to a pair of mutually hinged auxiliary rods, which at their individual other ends are pivotally connected to points 10 at the lower parts of the scissor arms. During the lifting process, a wedge is inserted below the point in which the auxiliary rods are hinged together. The hinge point is thereby influenced by the wedge with a force making it move upwards in a curve, the course of which 15 depends on the lengths of the auxiliary rods and the geometry of their connections to the scissor arms. During this upward movement the scissor arms are influenced so that they move too and the desired lift occurs.

20 As far as the forces in the system is concerned, said lifting mechanism works very well, and, if a suitable rod geometry is provided for, the difference between the maximum and minimum motor torque can be kept at a factor two.

25 However, if a reasonable force utilization is to be obtained by said lifting mechanism, the geometry of the auxiliary rods, and thus the course of the curve to be followed by their hinge point, necessitates a certain height of the inserted wedge.

30 This entails the disadvantage that because of the height of the wedge the lifting mechanism cannot be collapsed completely, or, when the lifting mechanism is completely collapsed, the wedge protrudes upwards or downwards and thus contribute to the total height of 35 the lifting mechanism in its completely collapsed position.

It is the object of the invention to provide a lifting mechanism of the type described in the opening paragraph, in which an effective utilization of the force or the torque that the drive unit may supply is obtained, ensuring at the same time that the total height of the lifting mechanism when collapsed is kept low.

This object of the invention is met in that at the chassis of a lifting mechanism of the type mentioned in the opening paragraph a pivotal member is mounted, which is movable by means of the drive unit and displaceably connected to the rolling or sliding member in such a way that during its pivotal movement the pivotal member displaces the platform vertically via the rods and the scissor arms.

In one advantageous embodiment, the pivotal member comprises an abutting surface for the rolling or sliding member.

Thus, the pivotal member may be designed as a solid arm on the surface of which the rolling or sliding member is displaceable.

More preferred, the pivotal member comprises a guide, preferentially in the form of a rail with a C- or a U-shaped cross-section, wherein the rolling or sliding member is displaceable.

This entails the advantage of the rolling or sliding member achieving a sideways stability, and in addition it is hidden away, which reduces the risk of squeeze injuries.

In another preferred embodiment, the pivotal member comprises a first lever arm and a second lever arm, which are permanently interconnected and form a constant angle to each other, whereby the first lever arm functions as a lever arm for the drive unit and the other lever arm comprises the abutting surface or the

guide, respectively.

This entails the advantage that it is possible to use a linear actuator, e.g. of the screw jack type.

In another advantageous embodiment, the force from 5 the drive unit to the pivotal member is transmitted to the rotational axis of the pivotal member directly.

This entails the advantage that the drive unit may be placed on the chassis in a fixed manner.

In the following the invention will be described 10 in detail by means of examples and with reference to the drawings, in which

Fig. 1 is a schematic perspective drawing of a lifting mechanism according to the invention, without a platform being mounted,

15 Fig. 2 is a diagram showing a lifting mechanism according to the invention, in a lowered position and with a platform being mounted,

Fig. 3 is a diagram showing the lifting mechanism according to Fig. 2, in an elevated position.

20 First of all reference is made to Fig. 1 showing a lifting mechanism according to the invention, whereby the platform to be vertically displaced is not shown, though.

The lifting mechanism comprises a chassis having 25 two side members 7, which, as shown, may be in the form of profiles with U-shaped cross-sections, but might as well be C-shaped or tubular profiles. As appears from Fig. 1, the mechanism is symmetrical in a plane halfway between the two side members 7.

30 Due to the symmetrical construction, the same reference numbers are used for identical parts.

The mechanism comprises two pairs of symmetrically placed scissor arms A, B, which are made of profiles with tubular cross-sections. At a point 9 dividing the 35 arms A, B into individual upper and lower parts, said

scissor arms A, B are pivotally interconnected in a scissor-like manner. Both the latter pivotal connection and the other pivotal connections of the lifting mechanisms are made of sleeve bushings with centre 5 bolts.

The lower part of the arms A is pivotally connected to an shaft 1, which, as shown, may advantageously be a transverse shaft 1 from side member 7 to side member 7, since this solution would contribute to 10 enhancing the stability and the rigidity of the chassis. Optionally, however, each of the arms A may also be individually hinged to a respective side member 7.

The lower ends 2 of the scissor arms B are guided in their individual side member 7, whereby the C- or U- 15 shaped cross-section of the side members serve as a guide rail 5 for rollers or protrusions mounted at said lower ends 2 of the scissor arms B. Thus, said lower ends 2 may reciprocate in the guide rails 5 upon changing scissor geometry.

20 The upper ends of the scissor arms B are connected to a mutual transverse shaft 2, at which the platform 8 may be hinged. Said transverse shaft also contributes to the stability of the platform.

The upper ends of the scissor arms A are connected 25 to a mutual transverse shaft 4 whereupon the platform 8 rests. The platform 8 is displaceable in relation to said transverse shaft 4 when the geometry of the scissors changes during a lifting or lowering movement. To prevent the platform 8 from unintentionally tilting it 30 may have a guide 6 for said transverse shaft 4. Optionally, the transverse shaft may comprise a cylinder or rolls. Instead of the transverse shaft 4, the individual upper ends of the arms A may be provided with rollers or protrusions guided in individual guides 6 35 mounted on the platform.

As shown in Fig. 1, the scissor arms A, B may advantageously be cranked and hinged to each other at protrusions 19A, 19B on said arms A, B since such a geometry leaves more room for the other parts of the mechanism when the lifting mechanism is in its lowered or collapsed position. In principle, however, there is nothing to prevent the use of the straight scissor arms, e.g. if available space is at hand, which is also implied in the block diagrams of Figs. 2 and 3.

10 In their individual point (10, 13), the lower parts of the scissor arms A, B are pivotally connected to the one end of their individual rod C, D. Each of said points is placed between the hinge point 9 of the scissor arms A, B and the individual lower parts 1, 2  
15 of same. The opposite ends of said rods are hinged to each other in a point 11, which also comprises a rolling or sliding member 12. Both rods C, D are made of flat bars. Furthermore, like the scissor arms A, B, they may be cranked in order not to get in the way for  
20 other parts of the lifting mechanism, e.g. the transverse rotary shaft 15, which will be described below.

When a force is applied to the hinge point 11, the force is transferred via the rods C, D as they move to the scissor arms A, B making those move too and cause  
25 the desired vertical displacement of the platform 8. During said process the hinge point 11 makes a curved movement. The shape of the curved movement depends on the geometry of the scissor arms A, B, the rods C, D and the connection points 10, 13 between those.

30 In order to apply the desired force to the hinge point 11, a pivotal element 20 is placed on the chassis. Said pivotal element 20 comprises a transverse rotary shaft 15 on which an arm in the form of a guide 14 is mounted, in which the rolling or sliding member 35 12 is guided. The guide 14 is formed as a rail made

from a C- or U-shaped cross-section, in which the rolling or sliding member 12 is reciprocately displaceable.

When the rotary shaft 15 is actuated to turn, the 5 guide 14 will pivot, e.g. from the lowered position shown in Fig. 2 to the elevated position shown in Fig. 3. Thereby the guide applies a force to the rods C, D at their mutual hinge point 11. As a comparison between Figs. 2 and 3 will show, it is achieved with appro-10 priately chosen lengths of the rods C, D that, upon the guide pivoting, the rolling or sliding member 12 will be displaced in the guide 14 in such a way that the distance to the rotary shaft 15 in the lowered position of the lifting mechanism shown in Fig. 2 is shorter 15 than in the elevated position of the lifting mechanism shown in Fig. 3. Accordingly, the force applied to the point 11 at a given torque for the rotary shaft 15 is larger in the lowered position than in the elevated position of the lifting mechanism.

20 In the embodiment described, the used guide 14 is rectilinear, which is indeed a very practical design of a rail having a C- or U-shaped cross-section. Whenever a cross-section is not used, e.g. replaced by a ramp having a curved surface on which the rolling or sliding 25 member is displaced, it may, however, also be worth considering non-rectilinear types of curvatures which improves the transfer of force from the actuator F to the rods C, D.

Furthermore, it should be noted that the two 30 positions shown in Figs. 2 and 3 do not necessarily represent extreme positions and, therefore, cannot be regarded as reflecting how far the platform may be elevated or lowered, respectively.

In order to apply a torque to the rotary shaft 15 35 it is provided with a lever arm E in the form of a bent

plate which is welded on. At its end 17, the lever arm E is coupled to the longitudinally displaceable rod 18 on a linear actuator F. Preferably, said actuator F is of the screw jack type, however, any kind of linear 5 actuator is applicable, e.g. a hydraulic actuator. Said actuator F is hinged at its far end 16 in relation to the lever arm E so as to compensate for the vertical movement described by the point 17 at the end of the lever arm E when the rotary shaft 15 is turned and the 10 lever arm thus pivoting.

In an alternative embodiment, the rotary shaft 15 is direct-driven by a motor by means of a worm drive or an appropriate axial gear. If so, the motor may be mounted in a fixed manner in relation to the chassis.

15 Besides the reinforced connections at the ends 1, 4, the two internal parallel scissor arms A may be provided with auxiliary transversal or diagonal struts and/or plates. Besides contributing to the rigidity, a plate will also contribute to aesthetics since from 20 some angles it will make the lower parts of the lifting mechanism imperceptible.

Although, the invention has been described above on the basis of a lifting mechanism having two scissors placed at the sides of a platform, nothing forms an 25 obstacle to the invention being used in connection with lifting mechanisms having one pair of scissors or more than two.

## P A T E N T C L A I M S

1. Lifting mechanism for vertically displacing a platform (8) in relation to a chassis (7) and comprising a drive unit, at least one pair of arms (B, A) 5 which are pivotally connected like scissors in a point (9) dividing said arms (B,A) into upper and lower parts in a scissors-like manner, whereby the first ends (1, 2) of the arms of the pair of arms (B, A) are hinged to the chassis (7) and the platform (8), respectively, 10 whereas the opposite end (5) of one arm (B) is guided along a track (5) on the chassis (7) and the opposite end (4) of the other arm (A) supports the platform (8), and a first and a second rod (C, D), which at their individual one end are pivotally connected to each 15 other in a joint (11) having an associated rolling or sliding member (12), and at their individual other ends (10, 13) are pivotally connected to the lower parts of the first and the second arms, respectively, characterized in that at the chassis (7) a 20 pivotal member (20) is mounted, which is movable by means of the drive unit and displaceably connected to the rolling or sliding member (12) in such a way that during its pivotal movement the pivotal member (20) displaces the platform (8) vertically via the rods (C, 25 D) and the scissor arms (A, B).

2. Lifting mechanism according to claim 1, characterized in that the pivotal member (20) comprises an abutting surface for the rolling or sliding member.

30 3. Lifting mechanism according to claims 1 or 2, characterized in that the pivotal member (20) comprises a guide (14) in which the rolling or sliding member (12) may be displaced.

4. Lifting mechanism according to claim 1, 35 characterized in that the guide (14)

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comprises a rail.

5. Lifting mechanism according to claim 4, characterized in that the guide comprises a rail with a C-shaped cross-section.

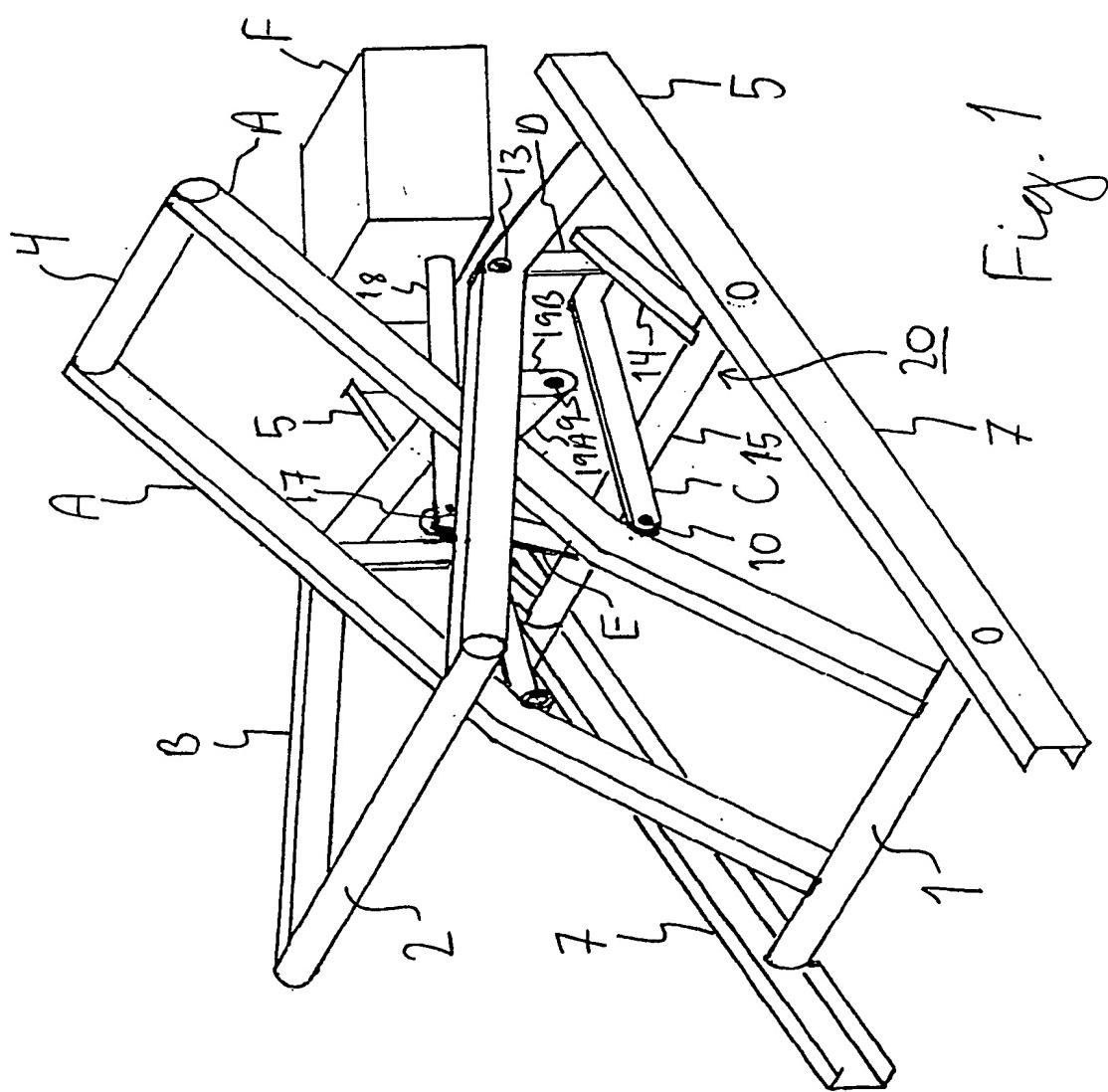
5 6. Lifting mechanism according to claim 4, characterized in that the guide comprises a rail with a U-shaped cross-section.

7. Lifting mechanism according to anyone of the preceding claims, characterized in that 10 the pivotal member (20) comprises a first lever arm (E) and a second lever arm (14), which are permanently interconnected and form a constant angle to each other, whereby the first lever arm (E) functions as a lever arm to the drive unit (F) and the other lever arm (14) 15 comprises the abutting surface or the guide.

8. Lifting mechanism according to anyone of the claims 1 to 6, whereby the power from the drive unit to the pivotal member (20) is transferred directly to the rotary shaft (15) of the pivotal member (20).

20 9. Lifting mechanism for vertically displacing a platform and essentially designed as described in the specification and shown in Fig. 1.

1 / 3



2 / 3

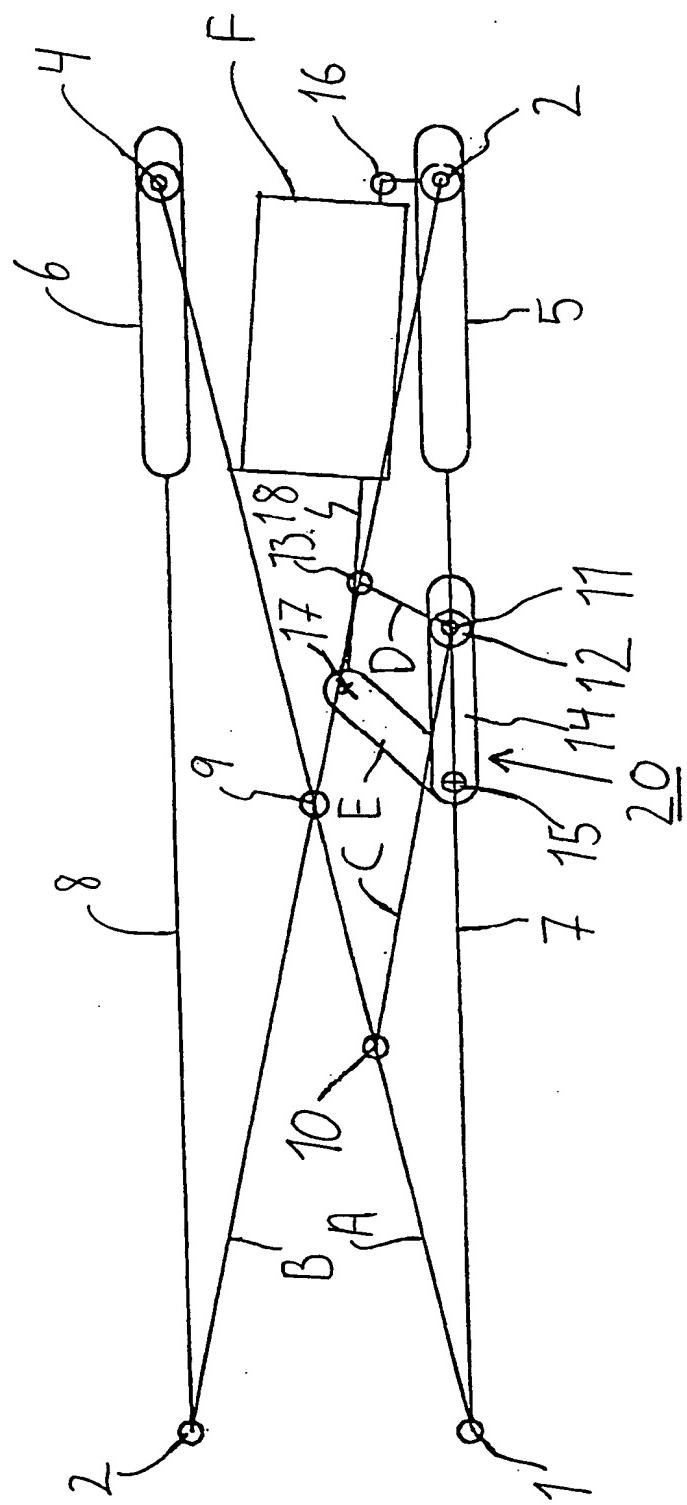
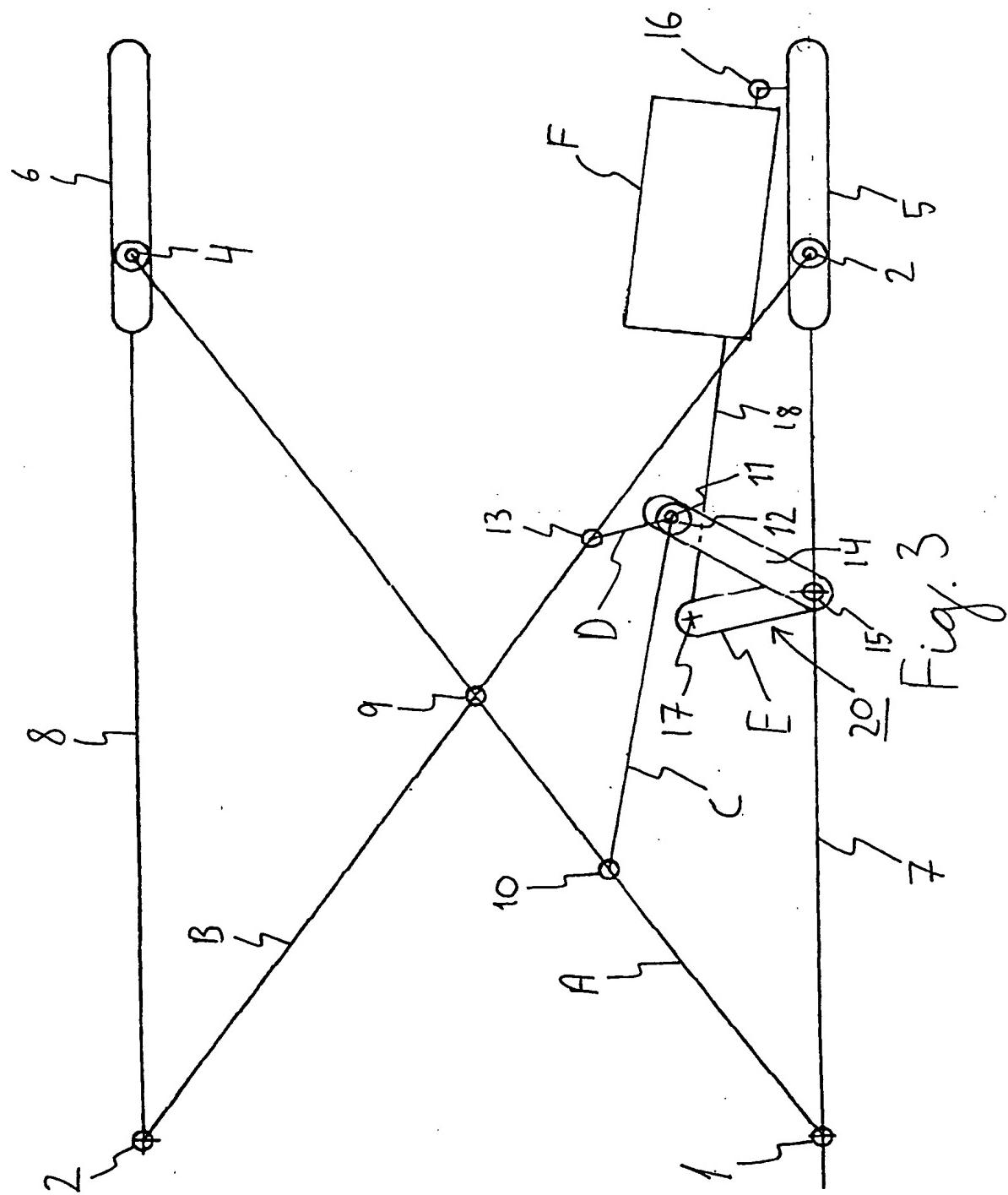


Fig. 2

3 / 3



## INTERNATIONAL SEARCH REPORT

International application No.

PCT/DK 99/00275

## A. CLASSIFICATION OF SUBJECT MATTER

**IPC6: B66F 7/06, B66F 3/22**

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

**IPC6: B66F**

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

**SE,DK,FI,NO classes as above**

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

**WPI, PAJ**

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 0839757 A1 (CHRISTENSEN, H.B.), 6 May 1998 (06.05.98), the whole document --	1-9
Y	DE 1082023 B (I. TREPEL), 19 May 1960 (19.05.60), figure 1 --	1-9
Y	US 2706102 A (A.L. CRESCI), 12 April 1955 (12.04.55), detail 41 in figure 1 --	3-6
A	EP 0372246 A1 (JLG INDUSTRIES, INC.), 13 June 1990 (13.06.90), details 41,42 in figure 3 --	7

 Further documents are listed in the continuation of Box C. See patent family annex.

- \* Special categories of cited documents:
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## INTERNATIONAL SEARCH REPORT

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## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,A	DE 19725480 C1 (TREPEL GMBH, HEBE- UND FÖRDERTECHNIK), 3 December 1998 (03.12.98), details 7,8 in figure 1-2  -- -----	7

**INTERNATIONAL SEARCH REPORT**

Information on patent family members

International application No.

30/08/99

PCT/DK 99/00275

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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EP 0372246 A1	13/06/90	AU 603519 B AU 4543589 A GB 2225771 A,B JP 2188396 A US 4890692 A	15/11/90 19/07/90 13/06/90 24/07/90 02/01/90
DE 19725480 C1	03/12/98	NONE	